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**DEMANDE  
DE BREVET D'INVENTION**

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(54) Composition à base de cendres volantes, pour le remplissage de tranchées, et application à la réfection de chaussées.

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La présente demande de brevet concerne le domaine de la réfection des routes , chaussées et trottoirs , et a plus particulièrement pour objet une composition pour le remplissage de tranchées ainsi que l'application de ces compositions à la réfection des routes et chaussées.

On sait que de nos jours les divers réseaux qui se présentent sous forme de canalisations , c'est-à-dire l'assainissement , l'eau, le gaz , ou de câbles , c'est-à-dire l'électricité et les télécommunications, sont situés dans le sous-sol pour des raisons techniques .

En zone urbanisée ces emplacements , réservés à chaque concessionnaire dans le sous-sol , nécessairement sous les chaussées et sous les trottoirs, sont d'ailleurs définis par des textes officiels.

Le développement de l'activité économique qui entraîne souvent le remplacement d'un matériel démodé par un autre plus moderne, des diverses interventions qui doivent être faites dans le cadre des réparations, implique inévitablement les reprises de ces réseaux par les divers concessionnaires soit pour effectuer des branchements, soit pour renouveler les réseaux , soit pour procéder à des extensions , à l'installation de nouveaux réseaux , en particulier dans les zones semi-urbanisées .

Il va de soi que la reprise de ces réseaux sur la voie publique nécessite le creusement de nombreuses tranchées pour accéder aux canalisations et aux câbles , et ce d'autant plus que la coordination qui devrait présider à ces travaux est souvent loin de l'idéal qu'il serait nécessaire de rechercher.

Lorsque les travaux de pose des ouvrages de collecte de distribution et de liaison sont terminés, le problème posé est celui de la réfection des sols.

On a calculé que les dépenses liées à ces réfections représentent en règle générale environ la moitié du coût d'un chantier de pose d'ouvrages .

De plus, la multiplicité des types de remblais et de réfections rencontrés ne facilite pas bien entendu les travaux, et ce d'autant plus que les règlements et les

spécifications imposés par les services officiels pour ce qui est de la nature, de la qualité et de l'épaisseur des matériaux exigés en remblais sont extrêmement variés.

5 Aux matériaux de remblais hétérogènes, sensibles à l'eau et sujets aux tassements sous la circulation lourde et intense des véhicules qui étaient utilisés à l'origine, on a substitué au cours du temps des matériaux plus élaborés tels que des sablons, graviers, tout-venants et similaires, naturels ou traités, aux liants hydrauliques ou hydrocarbonés.

10 Ces matériaux ont de commun qu'ils exigent un compactage intensif pour limiter les tassements ultérieurs.

Or, lorsque les tranchées ont des largeurs réduites il est difficile voire même impossible d'atteindre l'intensité de compactage prévue.

15 On peut également utiliser à titre de matériaux de remplissage du béton de ciment qui permet d'éviter le compactage, mais le coût est extrêmement élevé et le délai de prise ne permet pas un rétablissement rapide de la circulation, ce qui amène des nuisances pour les riverains et les  
20 usagers. En outre la dureté de ces matériaux rend plus difficile les interventions éventuelles ultérieures imposant d'ailleurs l'usage d'un marteau-piqueur.

25 Plus récemment, on a proposé d'utiliser à titre de matériaux de remplissage pour le remblaiement des tranchées, des cendres volantes issues de centrales thermiques et qu'on avait additionné de ciment.

30 On rappellera que ces cendres volantes sont un sous-produit des centrales thermiques qui utilisent, à titre de matériaux combustibles, le charbon pulvérisé. Ces cendres sont constituées de particules fines transportées par les fumées et captées en général dans des dépoussiéreurs électrostatiques avant évacuation par les cheminées.

35 Ces cendres, utilisées avec des ciments libérant de la chaux lors de la prise, exercent une action pouzzolanique, ces ciments utilisés étant de type CPA ou CPJ.

Toutefois, les essais de remplissage de tranchées à l'aide de mélanges constitués de cendres volantes, de ciment et d'eau se sont révélés tout à fait décevants, car le délai de prise était trop important, et le matériau, après  
5 ladite prise présentait un retrait et des fissurations bien entendu préjudiciables à une bonne tenue ultérieure.

La demanderesse a poursuivi des recherches pour palier les inconvénients précités et a mis au point un nouveau matériau de remplissage des tranchées, à base de  
10 cendres volantes et de ciment, qui est caractérisé en ce qu'il comprend :

a) environ 85 à 94% en poids sec de cendres volantes silico-alumineuses,

15 b) environ 6 à 12% de ciment,

c) de 0,5 à 3% d'un activant,

d) de l'eau dans une quantité comprise entre 30 et 60% en poids du mélange total a, b, et c.

Selon l'invention, il est souhaitable d'utiliser un ciment de classe 45 ou 55.

20 L'activant, utilisé aux fins de la présente invention, est un moyen destiné à accélérer la prise du ciment ainsi que la prise des cendres volantes. Il assure également une action expansive permettant d'annuler sensiblement ou tout au moins de réduire dans des grandes proportions le  
25 retrait de prise du matériau et les fissurations qui pourraient s'ensuivre.

A titre d'activant pouvant être utilisé dans la composition pour le remplissage de tranchées, on citera l'aluminate de sodium, le sulfate de calcium anhydre ou hydraté, le phosphogypse, ou les boues rouges.  
30

L'aluminate de sodium et le sulfate de calcium sont des corps connus en soi et il n'est donc pas nécessaire de préciser davantage leur nature.

Toutefois, on notera qu'ils peuvent se présenter  
35 tous deux sous forme pulvérulente. L'aluminate de sodium peut également être utilisé en solution aqueuse, dont la concentration est de l'ordre généralement d'environ 36%.

Le sulfate de calcium hydraté est également dénommé "gypse" et peut être utilisé aux fins de l'invention.

5 Le phosphogypse est un résidu de l'attaque de la fluorapatite (complexe de phosphate tricalcique et de fluorure de calcium) par l'acide sulfurique. C'est donc un sulfate de calcium hydraté qui se présente sous la forme d'un sable humide très fin.

10 Les boues rouges sont les résidus du traitement de l'alumine, et sont constituées d'oxyde d'aluminium, de titane, de fer, de silice, et d'un produit de désilication, qui est un mélange de composés alcalins, en particulier de sulfate d'aluminium et de sodium.

15 Ces boues rouges se présentent généralement sous la forme d'un coulis non décanté ou d'une pâte selon bien entendu leur teneur en eau.

20 On notera qu'il peut être particulièrement intéressant d'utiliser, à titre d'activant, l'aluminate de sodium en solution à 36%, car bien qu'il soit nécessaire d'utiliser dans ce cas un dosage triple par rapport à l'aluminate de sodium pulvérulent, la miscibilité au coulis est beaucoup plus élevée, ce qui permet de réduire la durée des opérations de malaxage.

25 Le sulfate de calcium anhydre, également dénommé anhydrite synthétique, est généralement produit par traitement du fluorure de calcium (ou spath fluor) par l'acide sulfurique.

30 Du fait de ces conditions de fabrication, le sulfate de calcium anhydre contient fréquemment de faibles quantités d'acide sulfurique et sa neutralisation peut être effectuée par une quantité calculée de chaux.

L'intérêt de l'utilisation de sulfate de calcium anhydre est la réduction du dosage en ciment, puisque les proportions de ciment se situent dans ce cas aux environs de 7%.

35 Le second intérêt de l'utilisation de ce composé réside dans la valorisation du sous-produit que constitue le sulfate de calcium anhydre.

Il va de soi que les compositions selon l'invention peuvent également contenir des adjuvants connus en soi et couramment utilisés dans ce domaine.

5 A titre d'illustration, on citera parmi ces adjuvants qu'il est possible d'incorporer, des plastifiants, entraîneurs d'air, fluidifiants et similaires.

10 L'invention a également pour objet un procédé pour la réfection de routes, chaussées et trottoirs et plus particulièrement pour le remplissage de tranchées, ce procédé étant caractérisé en ce qu'on utilise à titre de matériaux de remplissage une composition telle que définie précédemment et que, environ 24 heures après l'opération de remplissage on coule la couche de roulement, de façon connue en soi, en matériaux enrobés du type asphalte ou similaire.

15 A titre d'illustration, on décrira maintenant un exemple de mise en oeuvre de l'invention selon les caractéristiques précédemment évoquées.

20 1°) On a réalisé une composition destinée à assurer le remplissage d'une tranchée qui est constituée de cendres volantes, de ciment de type 45, d'un activant qui était constitué par du sulfate de calcium anhydre et par de l'eau, chacun de ces constituants étant présent dans les compositions définies dans la présente description.

25 Afin de définir les propriétés de la composition ainsi réalisée, on a formé des barreaux ou éprouvettes de 4 cm x 4 cm x 16 cm.

-Après 7 jours de conservation à l'air, on a effectué des essais en traction par flexion et on a obtenu des résistances comprises entre  $2.10^5$  Pa et  $7.10^5$  Pa.

30 -Après des conservations de 2 jours à l'air et 5 jours dans l'eau, ces résistances en traction par flexion mesurées sur des éprouvettes normalisées de même dimension étaient comprises entre  $2.10^5$  Pa et  $7.10^5$  Pa.

35 2°) On a également effectué des essais en compression simple mesurés sur des éprouvettes cylindriques de 10 cm de diamètre et de 20 cm de hauteur.

-Après 28 jours de conservation dans l'eau, les valeurs obtenues étaient supérieures à  $9.10^5$  Pa.

-Après 28 jours de conservation à l'air, les résistances étaient supérieures à  $11.10^5$  Pa.

5 -Après 90 jours de conservation dans l'eau les résistances en compression simple étaient supérieures à  $10.10^5$  Pa.

-Après 90 jours de conservation dans l'air, les résistances étaient supérieures à  $13.10^5$  Pa.

10 3°) Afin de tester la tenue des compositions dans les tranchées elles-mêmes, on a effectué des essais sur la profondeur d'ornièrre à l'aide d'un matériel approprié nommé ornièrreur L.P.C.

Après 100.000 cycles à une température de  $20^\circ\text{C}$ ,  
15 la profondeur d'ornièrre mesurée était négligeable.

4°) Des essais de poinçonnement ont également été effectués après 48 heures et sous une pression de  $13 \times 10^5$  Pa.

Le poinçonnement mesuré était inférieur à 2 mm.

20 5°) On a également observé le retrait de prise et les fissurations et ceux-ci étaient nuls ou négligeables.

En règle générale, les compositions ou mélanges selon l'invention peuvent supporter la circulation des piétons après 4 heures, et la circulation de véhicules après 24 à 48  
25 heures selon l'intensité de la circulation.

La résistance au poinçonnement, précédemment évoquée, est suffisante après 24 heures pour recevoir une couche de roulement en matériaux enrobés.

Les résultats des essais dont le compte-rendu à  
30 a été effectué précédemment mettent particulièrement en relief les excellents résultats obtenus à l'aide du matériau de remplissage selon l'invention.

D'autre part, on notera que la fabrication, le transport et la mise en oeuvre de ces compositions ne sont pas  
35 différents de ceux mis en oeuvre pour les coulis classiques.

Les cendres volantes et le ciment sont généralement dosés et mélangés en centrale ou dans un malaxeur,

selon l'importance des quantités mises en oeuvre, avec l'eau d'apport.

Le transport s'effectue de façon usuelle en toupie à béton, en pétrin automoteur, ou par tout autre moyen  
5 adapté aux conditions du chantier.

Bien entendu, l'activant doit être introduit sur le site avant l'application du coulis. Ledit activant est incorporé au mélange grâce à un brassage énergique pendant plusieurs minutes, de façon à obtenir une dispersion correcte  
10 de celui-ci avant la mise en oeuvre du coulis ou matériau de remplissage.

Les autres adjuvants éventuellement présents dans les compositions selon l'invention seront rajoutés aux moments appropriés qui sont connus de l'homme du métier. En règle  
15 générale, les adjuvants utilisés pour améliorer la mise en oeuvre du coulis ne provoquent pas d'influence réciproque avec les activateurs susceptibles d'accroître le délai de prise ou de provoquer des fissurations.

Le cas échéant des essais de routine permettront  
20 de révéler d'éventuelles interactions.

D'autre part, la composition des cendres volantes pouvant bien entendu varier dans de grandes proportions selon les centrales thermiques considérées, et le combustible utilisé par celles-ci, des essais pourront être effectués par l'homme de  
25 l'art afin d'ajuster les proportions des divers constituants formant la composition selon l'invention. En tout état de cause ces cendres devront être silico-alumineuses, car des essais ont révélé que des cendres volantes sulfo-calciques ne permettaient pas d'aboutir à des résultats satisfaisants.

Il s'agit là d'essais de routine à la portée de  
30 l'homme du métier.

Comme il a été déjà indiqué dans la présente description, la nature et proportion des constituants formant la composition présentement revendiquée pourront être modifiées  
35 par l'homme de l'art en fonction des problèmes particuliers à résoudre dans chaque cas.



REVENDEICATIONS

1. Composition pour le remplissage de tranchées à base de cendres volantes et de ciment, caractérisée en ce qu'elle comprend:

- 5                   a) environ 85 à 94% en poids sec de cendres volantes silico-alumineuses,  
                  b) environ 6 à 12% de ciment,  
                  c) de 0,5 à 3% d'un activant,  
                  d) de l'eau dans une quantité comprise entre 30 et 60% en poids du mélange a, b et c.

10               2. Composition selon la revendication 1, caractérisée en ce que le ciment utilisé est de classe 45 ou 55.

                  3. Composition selon l'une des revendications 1 ou 2, caractérisée en ce que l'activant est de l'aluminate de sodium.

15               4. Composition selon l'une des revendications 1 ou 2, caractérisée en ce que l'activant est du sulfate de calcium anhydre.

                  5. Composition selon l'une des revendications 1 ou 2, caractérisée en ce que l'activant est du phosphogypse.

20               6. Composition selon l'une des revendications 1 ou 2, caractérisée en ce que l'activant est du gypse.

                  7. Composition selon l'une des revendications 1 ou 2, caractérisée en ce que l'activant est une boue rouge.

25               8. Composition selon la revendication 3, caractérisée en ce que l'aluminate de sodium est sous forme de solution aqueuse.

                  9. Composition selon la revendication 8, caractérisée en ce que la concentration en poids de ladite solution aqueuse est de l'ordre de 36%.

30               10. Composition selon l'une quelconque des revendications 3 à 6, caractérisée en ce que l'activant est sous forme pulvérulente.

35               11. Composition selon l'une quelconque des revendications 1 à 10, caractérisée en ce qu'elle contient en outre d'autres adjuvants connus en soi tels que notamment des plastifiants, entraîneurs d'air et fluidifiants.

12. Procédé pour la réfection des chaussées et routes et pour le remplissage de tranchées, caractérisé en ce qu'on utilise à titre de matériau de remplissage une composition selon l'une quelconque des revendications 1 à 11  
5 et qu'après environ 24 heures ou plus on coule la couche de roulement en matériaux enrobés, de façon connue en soi.

## Translation of FR 2512440

The present patent application relates to the field of the repair of the roads, roadways and trottoirs and more particularly has as an aim a composition for the backfilling of trench as well as the application of these compositions to the repair of the roads and roadways.

It is known that nowadays the various networks which are presented in the form of drains, i.e. the cleansing, water, the gas, or of cables, it is-àdire electricity and lestélécommunicationz is located in the basement for technical reasons

In residential area these sites, reserved for each dealer in the basement, necessarily under the roadways and the pavements, are defined besides by official texts.

The development of the economic activity quientrain often the replacement of the obsolete material by another more modern, of the various interventions which must be made within the framework of repairs, inevitably implies the resumptions of these networks by the various dealers either to carry out connections, or to renew the networks, or to proceed to extensions, àlins- tallation of new networks, as a private individual in the semi-urbanized zones.

It goes from oneself that the resumption of these networks on the way.

public the digging of many trenches requires to reach the drains and the cables, and this more especially as the coordination which should govern this work is often far del' idéal it ilserait necessary to seek.

When the work of installation of the works of collection of distribution-and connection is completed, the problem arising is that of the repair of the grounds.

It was calculated that the expenditure related to these repairs represents in general rule approximately half of the coGt of a building site of installation of works

Moreover, the multiplicity of the types of fill and repairs met does not facilitate work of course, and this more especially as the payments and the specifications imposed by the official services as regards nature, the quality and the thickness of materials required in fill are extremely varied.

For heterogeneous filling materials, sensitive to water and prone to compressings under the heavy and intense circulation of the vehicles which were used in the beginning, one substituted in the course of the time of materials more elaborate such as fine sands, gravels, all-coming and similar, natural or treated, with the hydraulic binders or hydrocarbon.

These materials have of commun run which they require an intensive compaction to limit later compressings.

However, when the trenches have reduced widths it is difficult and even impossible to reach the intensity of compaction envisaged.

One can also use as fill materials of the cement concrete which makes it possible to avoid the compaction, but the cost is extremely high and the time of catch does not allow a fast re-establishment of circulation, which brings harmful effects for the residents and the users. Besides in in addition to the hardness of these materials makes more difficult the later possible interventions imposing the use of a power pick.

More recently, one proposed to use as fill materials for the fill of the trenches, of the fly-ashes resulting from power stations and which one had added with cement.

It will be pointed out that these fly-ashes are a by-product of the power stations which use, as combustible materials, pulverized coal. These ashes consist of fine particles transported by the fume and in general collected in electrostatic precipitators before evacuation by the chimneys.

Cescendres, used with cements releasing of lime at the time of the catch, exert a pozzolanic action, these cements used being of type CPA ouCP3.

However, the tests of backfilling of trench using mixtures made up of fly-ashes, cement and water appeared completely disappointing, because the time of catch was too important, and the material, after the aforementioned catch presented a withdrawal and crackings of course prejudicial at a good later behaviour.

The applicant carried out research for stage the above mentioned disadvantages and developed a new fill material of the trenches, at base of fly-ashes and cement, which is characterized in that it includes/understands

- a) approximately 85 to 94% in dry weight of silico-aluminous fly-ashes,
- B) approximately 6 to cement 12%,
- C) from 0,5 to 3% of an activator,
- d) water in a quantity ranging between 30 and 60% in weight of the total mixture has, B, and C.

According to the invention, it is desirable to use cement of class 45 or 55.

The activator, used for purposes of this invention, is a means intended to accelerate the catch of cement as well as the catch of the fly-ashes. It also ensures an expansive action making it possible to cancel appreciably or at least to reduce in great proportions the setting shrinkage of material and crackings which could follow.

As activator which can be used in the composition for the backfilling of trenches, one will quote sodium aluminate, sulphate of anhydrous or hydrated calcium, phosphogypsum, or muds red.

The sodium aluminate and the calcium sulphate are bodies known in oneself and it is thus not necessary to specify their nature more.

However, it will be noted that they can present both pennies forms pulverulent. The sodium aluminate can also be used in aqueous solution, whose concentration is approximately the 36% of about generally.

The hydrated calcium sulphate is also called "gypsum" and can be used for purposes of the invention.

The phosphogypsum is a residue of the attack of the fluorapatite (complex of calcium phosphate and fluoru - calcium Re) by the sulphuric acid. It is thus a hydrated calcium sulphate which presents under the formed' a very fine wet sand.

Red muds are the residues of the treatment of alumina, and consist of oxyded' aluminium, titanium, iron, silica, and a product of desilication, which is a mixture of alkaline compounds, in particular of sodium and aluminium sulphate.

These red muds are generally appeared as a purée not elutriated or a paste according to of course their water content.

One noteraqu T it can be particularly intéressandt' to use, by way of activator, the aluminate of sodium in solution à36%, because although it is necessary to use in this case a triple proportioning compared to pulverulent sodium aluminate, miscibility with the purée is raised much, this which makes it possible to reduce the duration of the operations of malaxation.

Anhydrous calcium sulphate, also called anhydritesynthetic, est.généralement produced by treatment of fluoride of calcium (or fluorite) by the sulphuric acid.

Because of these conditions of manufacture, the anhydrous calcium sulphate frequently contains small quantities of sulphuric acid and its neutralization can be carried out by a calculated quantity of lime.



The interest of the use of anhydrous calcium sulphate is the reduction of cement proportioning, since the proportions of cement are in this case at the surroundings of 7%.

The second interest of the use of this compound lies in the valorization of the by-product which constitutes the anhydrous calcium sulphate.

It goes from oneself that the compositions according to the invention can also contain additives known in oneself and usually used in this field.

As illustration, one will quote among these additives which it is possible to incorporate, des' plasticizing, agents air-entraining, thinners and similar.

The invention also has as an aim a process for the repair of roads, roadways and pavements and more particularly for the backfilling of trenches, this process being characterized in that one uses as fill materials a composition such as previously definite and which, approximately 24 hours after the operation of filling one runs the wearing course, in a known way in oneself, out of materials coated with the type asphalts or similar.

As illustration, one will now describe an example of implementation of the invention according to characteristics' previously evoked.

10) One carried out a composition intended to ensure the filling of a trench which consists of fly-ashes, of cement of the type 45, an activator which was consisted by anhydrous calcium sulphate and water, each one of these components being present in the compositions defined in present description.

In order to define the properties of the composition thus carried out, one formed of the bars or test-tubes of 4 cm X 4 cm X 16 cm.

- After 7 days of conservation to the air, one carried out tensile tests by inflection and one obtained the resistances ranging between 2.105 Pa and 7.105Pa.

- After some 2 days to the air and 5 days conservations in water, these resistances in traction by inflection measured on standardized test-tubes of the same dimension were included/understood entre 2.105 Pa and 7.105Pa.

2) One also carried out unconfined compression tests measured on cylindrical test-tubes 10 cm in diameter and 20 cm height.

- After 28 days of conservation in water, the values obtained were higher than 9.105Pa.

- After 28 days of conservation to the air, resistances were higher à 11.105 Pa.

- After 90 days of conservation in water resistances in simple compression were higher than 10.105Pa.

- After 90 days of conservation in the air, resistances were higher à 13.105Pa.

30) In order to test the behaviour of the compositions in the trenches themselves, one carried out tests on the depth of rut using a suitable material appointed ornieror L.P.C.

After 100.000 cycles with a températ Re of 200C, the depth of measured rut was negligible.

40) Tests of punching were also carried out after 48 hours and under a pressure of 13 X 105 Pa.

Measured punching was lower than 2 Misters.

50) One also observed the setting shrinkage and crackings and those were null or negligible.

In general, the compositions or mixtures according to the invention can support the movement of the pedestrians after 4 a.m., and the circulation of vehicles after 24 to 48 hours according to the intensity of circulation.

Resistance to punching, previously evoked, is suffisante après 24 hours to receive coated a material wearing course.

The results of the tests whose report was carried out previously particularly highlight the excellent results obtained at the assistance of fill material according to the invention.

In addition, it will be noted that manufacture, transport and the implementation of these compositions are not different from those implemented for the traditional purées.

The fly-ashes and cement are generally proportioned and mixed in power station or in a mixer, according to the importance of the quantities implemented, with the water of contribution.

Transport is carried out in a usual way out of spinning top with concrete, motorized kneader, or by any other means adapted to the conditions of the project.

Of course, the activator must be introduced on the site before the application of the purée. The aforementioned activator is incorporated in the mixture thanks to an energetic mixing during several minutes, in order to obtain a correct dispersion of this one before the implementation of the purée or fill material.

The other additives possibly present in the compositions according to the invention will be added at the suitable times which are known of the specialist of the profession. In general, the additives used to improve the implementation of the purée do not cause a reciprocal influence with the activators suitable for increase the time of catch or to cause crackings.

If necessary tests of routine will make it possible to reveal possible interactions.

In addition, the composition of the fly-ashes being able of course to vary in great proportions according to power stations' considered, and the fuel used by those, of the tests could be carried out by the expert in order to adjust the proportions of the various components forming the composition according to the invention. In any event these ashes will have to be silico-aluminous, because tests revealed that sulfo-calcic fly-ashes did not make it possible to lead to satisfactory results.

It acts there of tests of routine to the range of the specialist of the profession.

As it was already indicated in present description, the nature and proportion of the components forming at present asserted composition could be modified by the expert according to the problems particular to solve in each case.

## CLAIMS

1. Composition for the backfilling of trench containing fly-ashes and cement, characterized in that it includes/understands:

- a) approximately 85 to 94% in dry weight of silico-aluminous fly-ashes,
- B > approximately 6 to cement 12%,
- c) from 0,5 to 3% of an activator,
- d) water in a quantity ranging between 30 and 60% in weight of the mixture has, B and C.

2. Composition according to the claim 1, characterized in that cement used is of class 45 or 55.

3. Composition according to one of the claims 1 or 2, characterized in that the activator is sodium aluminate,
4. Composition according to one of the claims 1 or 2, characterized in that the activator is anhydrous calcium sulphate.
5. Composition according to one of the claims 1 or 2, characterized in that the activator is phosphogypsum.
6. Composition according to one of the claims 1 or 2, characterized in that the activator is gypsum.
7. Composition according to one of the claims 1 or 2, characterized in that the activator is a red mud.
8. Composition according to claim 3, characterized in that the sodium aluminate is in the form of aqueous solution.
9. Composition according to claim 8, characterized in that the concentration in weight of the aforesaid the aqueous solution is about 36%.
10. Composition according to any of claims 3 to 6, characterized in that the activator is in powder form.
11. Composition according to any of claims 1 to 10, characterized in that it contains moreover other additives known in oneself such as in particular of plasticizers, entrainers of air and thinners.
12. Proceeded for the repair of the roadways and roads and for the backfilling of trenches, characterized in that one uses as fill material a composition according to any of claims 1 to 11 and which after approximately 24 hours or more one runs coated the material wearing course , in a known way in oneself.



The present patent application relates to the field of the repair of the roads, roadways and trottoirs and more particularly has as an aim a composition for the backfilling of trench as well as the application of these compositions to the repair of the roads and roadways.

It is known that nowadays the various networks which are presented in the form of drains, i.e. the cleansing, water, the gas, or of cables, it is-àdire electricity and télécommunicationz is located in the basement for technical reasons.

In residential area these sites, reserved for each dealer in the basement, necessarily under the roadways and the pavements, are defined besides by official texts.

The development of the economic activity quientrain often the replacement of the obsolete material by another more modern, of the various interventions which must be made within the framework of repairs, inevitably implies the resumptions of these networks by the various dealers either to carry out connections, or to renew the networks, or to proceed to extensions, àlins- tallation of new networks, as a private individual in the semi-urbanized zones.

It goes from oneself that the resumption of these networks on the way.

public the digging of many trenches requires to reach the drains and the cables, and this more especially as the coordination which should govern this work is often far del' ideal it ilserait necessary to seek.

When the work of installation of the works of collection of distribution-and connection is completed, the problem arising is that of the repair of the grounds.

It was calculated that the expenditure related to these repairs represents in general rule approximately half of the coGt of a building site of installation of works.

Moreover, the multiplicity of the types of fill and repairs met does not facilitate work of course, and this more especially as the payments and the specifications imposed by the official services as regards nature, the quality and the thickness of materials required in fill are extremely varied.

For heterogeneous filling materials, sensitive to water and prone to compressings under the heavy and intense circulation of the vehicles which were used in the beginning, one substituted in the course of the time of materials more elaborate such as fine sands, gravels, all-coming and similar, natural or treated, with the hydraulic binders or hydrocarbon.

These materials have of commun run which they require an intensive compaction to limit later compressings.

However, when the trenches have reduced widths it is difficult and even impossible to reach the intensity of compaction envisaged.

One can also use as fill materials of the cement concrete which makes it possible to avoid the compaction, but the cost is extremely high and the time of catch does not allow a fast re-establishment of circulation, which brings harmful effects for the residents and the users. Besides in in addition to the hardness of these materials makes more difficult the later possible interventions imposing the use of a power pick.

More recently, one proposed to use as fill materials for the fill of the trenches, of the fly-ashes resulting from power stations and which one had added with cement.

It will be pointed out that these fly-ashes are a by-product of the power stations which use, as combustible materials, pulverized coal. These ashes consist of fine particles transported by the fume and in general collected in electrostatic precipitators before evacuation by the chimneys.



Cescendres, used with cements releasing of lime at the time of the catch, exert a pozzolanic action, these cements used being of type CPA ouCP3.

However, the tests of backfilling of trench using mixtures made up of fly-ashes, cement and water appeared completely disappointing, because the time of catch was too important, and the material, after the aforementioned catch presented a withdrawal and crackings of course prejudicial at a good later behaviour.

The applicant carried out research for stage the above mentioned disadvantages and developed a new fill material of the trenches, at base of fly-ashes and cement, which is characterized in that it includes/understands

- a) approximately 85 to 94% in dry weight of silico-aluminous fly-ashes,
- B) approximately 6 to cement 12%,
- C) from 0,5 to 3% of an activator,
- d) water in a quantity ranging between 30 and 60% in weight of the total mixture has, B, and C.

According to the invention, it is desirable to use cement of class 45 or 55.

The activator, used for purposes of this invention, is a means intended to accelerate the catch of cement as well as the catch of the fly-ashes. It also ensures an expansive action making it possible to cancel appreciably or at least to reduce in great proportions the setting shrinkage of material and crackings which could follow.

As activator which can be used in the composition for the backfilling of trenches, one will quote sodium aluminate, sulphate of anhydrous or hydrated calcium, phosphogypsum, or muds red.

The sodium aluminate and the calcium sulphate are bodies known in oneself and it is thus not necessary to specify their nature more.

However, it will be noted that they can present both pennies forms pulverulent. The sodium aluminate can also be used in aqueous solution, whose concentration is approximately the 36% of about generally.

The hydrated calcium sulphate is also called "gypsum" and can be used for purposes of the invention.

The phosphogypsum is a residue of the attack of the fluorapatite (complex of calcium phosphate and fluoru - calcium Re) by the sulphuric acid. It is thus a hydrated calcium sulphate which presents under the formed' a very fine wet sand.

Red muds are the residues of the treatment of alumina, and consist of oxyded' aluminium, titanium, iron, silica, and a product of desilication, which is a mixture of alkaline compounds, in particular of sodium and aluminium sulphate.

These red muds are generally appeared as a purée not elutriated or a paste according to of course their water content.

One noteraqu T it can be particularly intéressant' to use, by way of activator, the aluminate of sodium in solution à36%, because although it is necessary to use in this case a triple proportioning compared to pulverulent sodium aluminate, miscibility with the purée is raised much, this which makes it possible to reduce the duration of the operations of malaxation.

Anhydrous calcium sulphate, also called anhydritesynthetic, est.généralement produced by treatment of fluoride of calcium (or fluorite) by the sulphuric acid.

Because of these conditions of manufacture, the anhydrous calcium sulphate frequently contains small quantities of sulphuric acid and its neutralization can be carried out by a calculated quantity of lime.

The interest of the use of anhydrous calcium sulphate is the reduction of cement proportioning, since the proportions of cement are in this case at the surroundings of 7%.

The second interest of the use of this compound lies in the valorization of the by-product which constitutes the anhydrous calcium sulphate.

It goes from oneself that the compositions according to the invention can also contain additives known in oneself and usually used in this field.

As illustration, one will quote among these additives which it is possible to incorporate, des' plasticizing, agents air-entraining, thinners and similar.

The invention also has as an aim a process for the repair of roads, roadways and pavements and more particularly for the backfilling of trenches, this process being characterized in that one uses as fill materials a composition such as previously definite and which, approximately 24 hours after the operation of filling one runs the wearing course, in a known way in oneself, out of materials coated with the type asphalts or similar.

As illustration, one will now describe an example of implementation of the invention according to characteristics' previously evoked.

10) One carried out a composition intended to ensure the filling of a trench which consists of fly-ashes, of cement of the type 45, an activator which was consisted by anhydrous calcium sulphate and water, each one of these components being present in the compositions defined in present description.

In order to define the properties of the composition thus carried out, one formed of the bars or test-tubes of 4 cm X 4 cm X 16 cm.

- After 7 days of conservation to the air, one carried out tensile tests by inflection and one obtained the resistances ranging between 2.105 Pa and 7.105Pa.

- After some 2 days to the air and 5 days conservations in water, these resistances in traction by inflection measured on standardized test-tubes of the same dimension were included/understood entre 2.105 Pa and 7.105Pa.

2) One also carried out unconfined compression tests measured on cylindrical test-tubes 10 cm in diameter and 20 cm height.

- After 28 days of conservation in water, the values obtained were higher than 9.105Pa.

- After 28 days of conservation to the air, resistances were higher à 11.105 Pa.

- After 90 days of conservation in water resistances in simple compression were higher than 10.105Pa.

- After 90 days of conservation in the air, resistances were higher à 13.105Pa.

30) In order to test the behaviour of the compositions in the trenches themselves, one carried out tests on the depth of rut using a suitable material appointed ornieror L.P.C.

After 100.000 cycles with a températ Re of 200C, the depth of measured rut was negligible.

40) Tests of punching were also carried out after 48 hours and under a pressure of 13 X 105 Pa.

Measured punching was lower than 2 Misters.

50) One also observed the setting shrinkage and crackings and those were null or negligible.

In general, the compositions or mixtures according to the invention can support the movement of the pedestrians after 4 a.m., and the circulation of vehicles after 24 to 48 hours according to the intensity of circulation.

Resistance to punching, previously evoked, is suffisante après 24 hours to receive coated a material wearing course.

The results of the tests whose report was carried out previously particularly highlight the excellent results obtained at the assistance of fill material according to the invention.

In addition, it will be noted that manufacture, transport and the implementation of these compositions are not different from those implemented for the traditional purées.

The fly-ashes and cement are generally proportioned and mixed in power station or in a mixer, according to the importance of the quantities implemented, with the water of contribution.

Transport is carried out in a usual way out of spinning top with concrete, motorized kneader, or by any other means adapted to the conditions of the project.

Of course, the activator must be introduced on the site before the application of the purée. The aforementioned activator is incorporated in the mixture thanks to an energetic mixing during several minutes, in order to obtain a correct dispersion of this one before the implementation of the purée or fill material.

The other additives possibly present in the compositions according to the invention will be added at the suitable times which are known of the specialist of the profession. In general, the additives used to improve the implementation of the purée do not cause a reciprocal influence with the activators suitable for increase the time of catch or to cause crackings.

If necessary tests of routine will make it possible to reveal possible interactions.

In addition, the composition of the fly-ashes being able of course to vary in great proportions according to power stations' considered, and the fuel used by those, of the tests could be carried out by the expert in order to adjust the proportions of the various components forming the composition according to the invention. In any event these ashes will have to be silico-aluminous, because tests revealed that sulfo-calcic fly-ashes did not make it possible to lead to satisfactory results.

It acts there of tests of routine to the range of the specialist of the profession.

As it was already indicated in present description, the nature and proportion of the components forming at present asserted composition could be modified by the expert according to the problems particular to solve in each case.

## CLAIMS

1. Composition for the backfilling of trench containing fly-ashes and cement, characterized in that it includes/understands:

- a) approximately 85 to 94% in dry weight of silico-aluminous fly-ashes,
- B > approximately 6 to cement 12%,
- c) from 0,5 to 3% of an activator,
- d) water in a quantity ranging between 30 and 60% in weight of the mixture has, B and C.

2. Composition according to the claim L, characterized in that cement used is of class 45 or 55.



3. Composition according to one of the claims 1 or 2, characterized in that the activator is sodium aluminate,
4. Composition according to one of the claims 1 or 2, characterized in that the activator is anhydrous calcium sulphate.
5. Composition according to one of the claims 1 or 2, characterized in that the activator is phosphogypsum.
6. Composition according to one of the claims 1 or 2, characterized in that the activator is gypsum.
7. Composition according to one of the claims 1 or 2, characterized in that the activator is a red mud.
8. Composition according to claim 3, characterized in that the sodium aluminate is in the form of aqueous solution.
9. Composition according to claim 8, characterized in that the concentration in weight of the aforesaid the aqueous solution is about 36%.
10. Composition according to any of claims 3 to 6, characterized in that the activator is in powder form.
11. Composition according to any of claims 1 to 10, characterized in that it contains moreover other additives known in oneself such as in particular of plasticizers, entrainers of air and thinners.
12. Proceeded for the repair of the roadways and roads and for the backfilling of trenches, characterized in that one uses as fill material a composition according to any of claims 1 to 11 and which after approximately 24 hours or more one runs coated the material wearing course , in a known way in oneself.